

ON THE VALUE OF THE "NEARCTIC" AS ONE OF THE PRIMARY ZOOLOGICAL REGIONS. REPLIES TO CRITICISMS BY MR. ALFRED RUSSEL WALLACE AND PROF. THEODORE GILL.

BY PROFESSOR ANGELO HEILPRIN.

The subjoined criticism by Mr. Alfred Russel Wallace on my paper entitled "On the Value of the 'Nearctic' as one of the Primary Zoological Regions," published in the Proceedings of the Academy for December, 1882, and my reply thereto, appear in *Nature* under dates of March 22 and April 26 of this year:—

"In the *Proceedings of the Academy of Natural Sciences of Philadelphia* (December, 1882), Prof. Angelo Heilprin has an article under the above title in which he seeks to show that the Nearctic and Palæarctic should form one region, for which he proposes the somewhat awkward name 'Triarctic Region,' or the region of the three northern continents. The reasons for this proposal are, that in the chief vertebrate classes the proportion of peculiar forms is less in both the Nearctic and Palæarctic than in any of the other regions; while if these two regions are combined, they will, together, have an amount of peculiarity greater than some of the tropical regions.

"This may be quite true without leading to the conclusion argued for. The best division of the earth into zoological regions is a question not to be settled by looking at it from one point of view alone; and Prof. Heilprin entirely omits two considerations—peculiarity due to the absence of widespread groups, and geographical individuality. The absence of the families of hedgehogs, swine and dormice, and of the genera *Meles*, *Equus*, *Bos*, *Gazella*, *Mus*, *Cricetus*, *Meriones*, *Dipus* and *Hystrix*, among mammals; and of the important families of fly-catchers and starlings, the extreme rarity of larks, the scarcity of warblers, and the absence of such widespread genera as *Acrocephalus*, *Hypolais*, *Ruticilla*, *Saxicola*, *Accentor*, *Garrulus*, *Fringilla*, *Emberiza*, *Motacilla*, *Yunx*, *Cuculus*, *Caprimulgus*, *Perdix*, *Coturnix*, and all the true pheasants, among birds, many of which groups may almost be said to characterize the Old World as compared with the New, must surely be allowed to have great weight in determining this question.

"The geographical individuality of the two regions is of no

less importance, and if we once quit these well-marked and most natural primary divisions we shall, I believe, open up questions as regards the remaining regions which it will not be easy to set at rest. There runs through Prof. Heilprin's paper a tacit assumption that there should be an equivalence, if not an absolute equality, in the zoological characteristics and peculiarities of all the regions. But even after these two are united, there will remain discrepancies of almost equal amount among the rest, since in some groups the Neotropical, in others the Australian, far exceed all other regions in their specialty. The temperate and cold parts of the globe are necessarily less marked by highly peculiar groups than the tropical areas, because they have been recently subjected to great extremes of climate, and have thus not been able to preserve so many ancient and specialized forms as the more uniformly warm areas. But, taking this fact into account, it seems to me that the individuality of the Nearctic and Palæartic regions is very well marked, and much greater than could have been anticipated; and I do not think that naturalists in general will be induced to give them up by any such arguments as are here brought forward.

“ALFRED R. WALLACE.”

Reply to the preceding :—

“Permit me to make a few remarks relative to Mr. Wallace's criticism (*Nature*, vol. xxvii, p. 482) of my paper on ‘The Value of the Nearctic as one of the Primary Zoological Regions.’ Briefly stated, it is maintained in the early portion of this paper (1) that the Nearctic<sup>1</sup> and Palæartic faunas taken individually exhibit, in comparison with the other regional faunas (at least the Neotropical, Ethiopian and Australian), a marked absence of *positive* distinguishing characters, a deficiency which in the mammalia extends to families, genera, and species, and one which, in the case of the Nearctic region, also equally (or nearly so) distinguishes the reptilian and amphibian faunas; (2) that this deficiency is principally due to the circumstance that many groups of animals which would otherwise be peculiar to, or very characteristic of, one or other of the regions, are prevented from

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<sup>1</sup> In the paper under consideration, I have given what appear to me satisfactory reasons for detaching certain portions of the Southwestern United States from the Nearctic (my Triarctic), and uniting them with the Neotropical region.

being such by reason of their being held in common by the two regions; and (3) that the Nearctic and Palæarctic faunas taken collectively are more clearly defined from any or all of the other faunas than either the Nearctic or Palæarctic taken individually.

“In reference to these points, Mr. Wallace, while not denying the facts, remarks: ‘The best division of the earth into zoological regions is a question not to be settled by looking at it from one point of view alone; and Prof. Heilprin entirely omits two considerations—peculiarity due to the absence of widespread groups, and geographical individuality.’ Numerous families and genera from the classes of mammals and birds are then cited as being entirely wanting in the western hemisphere, and which—in many cases almost sufficient to ‘characterize the Old World as compared with the New’—‘must surely be allowed to have great weight in determining this question.’ No one can deny that the absence from a given region of certain widespread groups of animals is a factor of very considerable importance in determining the zoological relationship of that region, and one that is not likely to be overlooked by any fair-minded investigator of the subject. But the value of this *negative* character afforded by the absence of certain animal groups as distinguishing a given fauna, is in great measure proportional to the extent of the positive character—that furnished by the presence of peculiar groups—and indeed may be said to be entirely dependent on it. No region can be said to be satisfactorily distinguished from another without its possessing both positive and negative distinguishing characters. Mr. Wallace has in his several publications laid considerable stress upon the negative features of the Nearctic fauna as separating it from the Palæarctic or from any other, but he has not, it appears to me, sufficiently emphasized the great lack, *when compared to other faunas*, of the positive element, the consideration of which is the point aimed at in the first portion of my paper, and which has led to the conclusions already stated—that only by uniting the Nearctic and Palæarctic regions do we produce a collective fauna which is broadly distinguished by both positive and negative characters from that of any other region. If, as Mr. Wallace seems to argue, the absence from North America of the ‘families of hedgehogs, swine and dormice, and of the genera *Meles*, *Equus*, *Bos*, *Gazella*, *Mus*, *Cricetus*, *Meriones*,

*Dipus* and *Hystrix*, be sufficient, as far as the mammalian fauna is concerned, to separate that region from the Palæarctic, could not on nearly equally strong grounds a separation be effected in the Palæarctic region itself? Thus, if we were to consider the western division of the Palæarctic region, or what corresponds to the continent of Europe of geographers, as constituting an independent region of its own, it would be distinguished from the remainder of what now belongs to the Palæarctic region by negative characters probably fully as important as those indicated by Mr. Wallace as separating the Nearctic from the Palæarctic region. The European mammalian fauna would be wholly deficient, or nearly so, in the genera *Equus*, *Moschus*, *Camelus*, *Poepagus*, *Gazella*, *Oryx*, *Addax*, *Saiga*, *Ovis*, *Lagomys*, *Tamias*, in several of the larger *Felidæ*, as the tiger and leopard, and in a host of other forms. A similar selection could be made from the class of birds (among the most striking of these the *Phasi-**anidæ* and *Struthionidæ*), but it is scarcely necessary in this place to enter upon an enumeration of characteristic forms. Divisions of this kind, to be characterized principally or largely by negative faunal features, could be effected in all the regions, and in some instances with probably more reason than in the case under discussion.

“But the question suggests itself, what amount of characters, whether positive or negative, or both, is sufficient to distinguish one regional fauna from another? Mr. Wallace states: ‘There runs through Prof. Heilprin’s paper a tacit assumption that there should be an equivalence, if not an absolute equality, in the zoological characteristics and peculiarities of all the regions.’ Is it to be inferred from this quotation that Mr. Wallace recognizes no such general equivalence? Is a region holding in its fauna, say from 15 to 20 per cent. of peculiar or highly characteristic forms, to be considered equivalent in value to one where the faunal peculiarity amounts to 60 to 80 per cent.? If there be no equivalence of any kind required, why not give to many of the subregions, as now recognized, the full value of region?

“Surely, on this method of looking at the question, a province could readily be raised to the rank of a full region. In the matter of geographical individuality little need be said, as the circumstance, whether it be or be not so, that the ‘temperate and cold parts of the globe are necessarily less marked by highly

peculiar groups than the tropical areas, because they have been recently subjected to great extremes of climate,' does not affect the present issue, seeing that the peculiarity is greatly increased by uniting the two regions in question; nor does it directly affect the question of the Nearctic-Palæartic relationship.

"The second part of my paper deals with the examination of the reptilian and amphibian faunas, and the general conclusion arrived at is: 'That by the community of its mammalian, batrachian and reptilian characters, the Nearctic fauna (excluding therefrom the local faunas of the Sonoran and Lower Californian subregions, which are Neotropical) is shown to be of a distinctively Old World type, and to be indissolubly linked to the Palæartic (of which it forms only a lateral extension). Towards this conclusion, which, it is claimed, is also borne out by the land and fresh-water mollusca and the butterflies among insects, I am now happy to add the further testimony of Mr. Wallace (overlooked when preparing my article) respecting the *Coleoptera* ('Distribution,' 'Encycl. Britann.,' 9th ed., vii, p. 274).

"As regards the name 'Triartic,' by which I intended to designate the combined Nearctic and Palæartic regions, and which may or may not be 'somewhat awkward,' I beg to state that, at the suggestion of Prof. Alfred Newton (who, as he informs me, has arrived from a study of the bird faunas at conclusions approximately identical with my own), it has been replaced by 'Holarctic.' In conclusion, I would say that, while the views enunciated in my paper may not meet with general acceptance at the hands of naturalists, it is to be hoped that they will not be rejected because they may 'open up questions as regards the remaining regions which it will not be easy to set at rest.'

“ANGELO HEILPRIN.

“*Academy of Natural Sciences, Philadelphia, April 6.*”

In the issue of *Nature* for June 7, Prof. Theodore Gill, in an article entitled "The Northern Zoogeographical Regions," submits the following criticisms on my paper supplementary to those of Mr. Wallace:—

"The facts of zoogeography are so involved, and often apparently contradictory, that a skilful dialectician with the requisite knowledge can make a plausible argument for antithetical postu-

lates. Prof. Heilprin being a skilful dialectician and well informed, has submitted a pretty argument in favor of the union of the North American or 'Nearctic' and Eurasiatic or 'Palæarctic' regions (*Proc. Acad. Nat. Sci. Phil.*, 1882, pp. 316-334, and *Nature*, vol. xxvii, p. 606), but Mr. Wallace has, with perfect justness it seems to me, objected to his proposition (*Nature*, vol. xxvii, pp. 482, 483). As Prof. Heilprin's arguments have not been entirely met, however, permit me to submit some further objections to his views.

"Prof. Heilprin has contended '(1) that by family, generic, and specific characters, as far as the mammalia are concerned, the Nearctic and Palæarctic faunas taken collectively are more clearly defined from any or all of the other regions than either the Nearctic or Palæarctic taken individually; and (2) that by the community of family, generic and specific characters the Nearctic region is indisputably united to the Palæarctic, of which it forms a lateral extension.'

"Prof. Heilprin has formulated these conclusions after a summary of the families and genera common and peculiar to the regions in question.

"As to families Prof. Heilprin has presented the following figures:—

	All.	Peculiar.
Nearctic, . . . . .	26	1
Palæarctic, . . . . .	36	0
Oriental, . . . . .	36	3
Australian, . . . . .	22	8
Ethiopian, . . . . .	44	9
Neotropical, . . . . .	31	8

"The proportions of peculiar genera to the entire mammalian faunas of the several regions are stated to be as follows:—

	All.	Peculiar.	Percentage.
Nearctic, . . . . .	74	26	35
Palæarctic, . . . . .	100	35	35
Oriental, . . . . .	118	54	46
Australian, . . . . .	70	45	64
Ethiopian, . . . . .	142	90	63
Neotropical, . . . . .	131	103	78

"The question may naturally recur, why the line which sep-

arates 'regions' from 'subregions' should be drawn between 35 and 46 per cent. rather than between 46 and 63 or 64 per cent., or even between 64 and 78 per cent. Prof. Heilprin has not told us why, and I am unable to appreciate the reason therefor. Surely it is not sufficient to answer by simply asking the question put in *Nature* (p. 606).

"But an analysis of more (but only approximately) correct figures and a more logical classification of mammals than that adopted by Prof. Heilprin reveal factors materially contravening the tabular statements of that gentleman.

"First we must exclude the marine mammals, because their distribution and limitation are determined by other factors than those which regulate the terrestrial ones. A consideration then of the terrestrial forms leads to the following results:—

"The Arctamerican or Nearctic region has twenty-seven families, of which eleven are not shared with Eurasia and four are peculiar; it has sixty-eight genera, of which forty-five do not enter into Eurasia.

"The Eurasiatic or Palæarctic region has thirty-two<sup>1</sup> families, of which seventeen are excluded from North America, and it possesses eighty-nine<sup>1</sup> genera, of which sixty have failed to become developed in America.

"Such contrasts will more than compare generally with those existing between Eurasia and India, and even between the 'Tri-arctic' or 'Holarctic' and Indian 'regions,' and the same destructive process by which the northern regions are abrogated would entail the absorption of the Indian as well into a heterogeneous whole. The three can in fact be well united (as Cænogæa), and contrasted with a group (Eogæa) consisting of the African, South American, and Australian regions, as I long ago urged (*Ann. and Mag. Nat. Hist.* [4], xv, 251-255, 1875), but the claims of each to be considered as 'regions' or realms are not thereby affected.

"THEO. GILL

"*Smithsonian Institution, Washington, May 12.*"

The above criticisms of Prof. Gill fall into two distinct categories, which may be conveniently formulated as follows:—

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<sup>1</sup> These are the groups admitted by Prof. Heilprin, exclusive of the Pinnipeds.

1. Accepting the data as given, are the conclusions drawn from them necessarily correct?

2. Are the data themselves correct?

The first of the questions is answered by a negative in interrogation, if so it may be termed. Prof. Gill objects to my (?) method of distinguishing between the larger and smaller zoogeographical divisions, and pointingly submits that "The question may naturally recur, why the line which separates 'regions' from 'sub-regions' should be drawn between 35 and 46 per cent. rather than between 46 and 63 or 64 per cent., or even between 64 and 78 per cent. Prof. Heilprin has not told us why, and I am unable to appreciate the reason therefor. Surely it is not sufficient to answer by simply asking the question put in *Nature* (p. 606)." The problem here stated is certainly one that does not admit of a ready logical solution, and one which the writer has never attempted to solve; nor, as far as he is aware, has its solution ever been effected by any other writer on zoogeography. 78 is indisputably as near to 64 as this last is to 46, and but little less near than 46 is to 35; and if one or two more terms be added to the series, it may still be contended with equal justice that 46 holds approximately the same relation (in this sense) to 35 as 35 does to 25, and 25 to 15 as 15 to 5, and so to either end. So far, well and good. But the fact still remains, nevertheless, that a region whose fauna is characterized by 90 or 78 per cent. of peculiarities is *eminently* well defined from any and all other regions; that one whose peculiarities amount to 64 or 46 per cent. is *considerably less* well-defined; and that another, where the peculiarity amounts to only 15 or 10 per cent., is still less well-defined, and, in fact, scarcely defined at all. If a line of division or separation is to be drawn at all it must be drawn somewhere, and this somewhere must be dictated in great part by common sense.

As regards the second question (2), Prof. Gill is much more emphatic in his (negative) reply. In the first place, it is pleaded that the marine mammals ought to have been excluded from any analysis bearing upon the subject of zoogeography, "because their distribution and limitation are determined by other factors than those which regulate the terrestrial ones." But surely if these forms are to be excluded, we might for almost identical reasons exclude the birds, since in the distribution of this class of animals factors are involved which are in no way operative in



the dispersal of several other classes of land animals, such as the mammals, reptiles, mollusks, etc. And yet it is largely, indeed it might be said almost wholly, upon the distribution of birds that the principles of zoogeography, with its existing classification, were originally sketched out. Granting, however, for the sake of argument, the justice of plea made, are the results in any way materially affected or altered? Most emphatically not, as will be made manifest by an examination of the accompanying tables, where the original and new (or reduced) data are placed immediately under each other:—

Of 26 Nearctic families (land and marine) 19 are also Palæarctic = 74 per cent.

Of 23 Nearctic families (land only) 16 are also Palæarctic = 70 per cent.

Of 74 Nearctic genera (land and marine) 35 are also Palæarctic = 47 per cent.

Of 62 Nearctic genera (land only) 26 are also Palæarctic = 42 per cent.

Of 74 Nearctic genera (land and marine) 26 are peculiar = 35 per cent.

Of 62 Nearctic genera (land only) 23 are peculiar = 37 per cent.

The 26 peculiar Nearctic genera (land and marine) comprise 60 species, or 21 per cent. of the entire number (279) of species.

The 23 peculiar Nearctic genera (land only) comprise 57 species, or 21 per cent. of the entire number (267) of land species.

It will thus be seen that the greatest variation in any place is only *five* per cent. If, as has been done in my paper, we unite the Nearctic and Palæarctic regions, we will then have, as claimed:—

86 peculiar genera (land and marine) out of a total of 139 = 62 per cent.; or, deducting the marine forms—

74 peculiar genera out of a total of 127 land forms = 58 per cent.

And if we consider the specific forms represented by these peculiar genera, we have—

284 out of a total of 675 (land and marine) = 42 per cent.; or, deducting the marine forms—

264 out of a total of 655 land forms = 40 per cent.

Here again, therefore, the variation is reduced to an insignificant amount—to 4 and 2 per cent.

It has been further objected, that "a more logical classification of mammals" than that which has been followed in my paper, would reveal facts materially contravening my tabular statements, but Prof. Gill fails to inform us what this "more logical classification" may be, and it therefore becomes impossible to theorize on his premises.<sup>1</sup> The distinguished naturalist of Washington is, however, certainly in error when he maintains that the Arctamerican fauna has 4 (instead of 2—*Haploödontidæ* and *Zapodidæ*—or at the utmost, including the not generally recognized *Antilocapridæ*, 3) peculiar families; nor can we understand from his data how, if 29 Eurasiatic genera are represented in Arctamerica, only 23 Arctamerican genera are developed in Eurasia.

From what has already been said it will be seen that there is nothing in either Mr. Wallace's or Prof. Gill's arguments which might tend towards altering my views on the question at issue; and I must therefore still maintain, in the face of the evidence before us, that, in my judgment, there is not even the shadow of a peg upon which to hang the Nearctic (as distinct from the Palæartic) region of zoogeographers.

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<sup>1</sup> There can be no doubt that certain emendations to the classification followed might have been advantageously made; as, for example, by the introduction of the genus *Cariacus*; but the very few alterations that could have been suggested through the works of the most recent, and, as usually recognized, most competent authorities on the subject of the mammalia, would produce no really appreciable difference in the result.